5.4 GEOLOGY AND SOILS

The purpose of this section is to describe geological and soil conditions in the project area and to evaluate potential impacts of the proposed project on these features.

5.4.1 Setting

5.4.1.1 Geology

The project is located in southern San Luis Obispo County, which is situated in the southern Coast Ranges geomorphic province of California. The southern Coast Ranges geomorphic province extends from Point Arguello in the south to the Oregon border in the north and ranges from 20 to 80 miles in width. The Coast Ranges province is bounded on the south by the Transverse Ranges geomorphic province, on the east by the Central Valley, on the north by the Klamath Ranges geomorphic province, and on the west by the Pacific Ocean.

The Coast Ranges geomorphic province is characterized by a series of northwest trending mountain ranges and valleys, many of which are bounded by faults. Rocks exposed in the southern Coast Ranges province include igneous, sedimentary and metamorphic rocks ranging in age from Jurassic to recent (see Figure 5.4-1).

San Luis Obispo County is traversed by five mountain ranges: the Santa Lucia Range, the Temblor Range, the Caliente Range, the La Panza Range and the San Luis Range. The Arroyo Grande Oil Field is located in Price Canyon in the southern portion of the San Luis Range.

The oldest rocks in the San Luis Range belong to the Jurassic-aged Franciscan formation, which forms the basement complex. The Franciscan formation is predominantly comprised of graywacke sandstone, with lesser amounts of shale, limestone, chert, and altered submarine volcanic rocks. Thickness of the Franciscan formation is estimated to be in excess of 25,000 feet. The Franciscan formation is unconformably overlain in the Arroyo Grande Oil Field by the Miocene-aged Monterey and Miocene/Pliocene-aged Pismo formations (ERCO 1981).

The Monterey formation is composed primarily of siliceous and porcelanous shales interbedded with dolomite/limestone, chert, and volcanic ash. The Monterey formation in the Arroyo Grande Oil Field is subdivided into four members: the Tuffaceous Member (Tmmt), the Siliceous Member (Tmmp), the Diatomaceous Member (Tmmd), and the Silty Member (Tmms) (ERCO 1981). Although no hydrocarbons are directly produced from the Monterey Formation, it is believed to be the source rock for the Arroyo Grande field reservoirs. No exploratory borings or wells have been drilled through the entire thickness of the formation, which is believed to be approximately 1,000 to 1,400 feet thick (Dames & Moore 1986).

The late Mio-Pliocene Pismo formation unconformably overlies the Monterey formation and consists of lenticular fine to coarse grained friable sandstone, calcareous siltstone, pebble conglomerate, and siliceous, cherty shale. The Pismo formation in the Arroyo Grande Oil Field area is subdivided into the Edna Member (late Miocene), an intermediate undifferentiated Member, and the Squire Member (Pliocene). The Edna Member is a massive buff to white coarse-grained bituminous sandstone, with layers of course pebble- or boulder-size components appearing randomly throughout the member. Bedding throughout the massive sands is indistinct or absent, with the exception of coarse-grained gravels or horizons of erosional contacts (Dames & Moore 1986).

In addition to the consolidated rock formations, recent alluvial deposits are present in the channel and flood plain of Pismo Creek. The alluvial sediments are comprised of silt, sand, and gravel and reach a maximum thickness of 100 feet near the center of the valley, becoming thinner at the margins of the valley.

5.4.1.2 Geologic Structure

The Arroyo Grande Oil Field lies within a structurally complex area. Significant faults in the area include the Hosgri, Nacimiento, West Huasna, and Rinconada faults. Smaller faults include the Los Osos fault zone, the Edna fault, the Indian Knob fault; the Wilmar Avenue, the Oceano, and the Pecho faults (see Figure 5.4-2). Fault movement includes reverse, strike-slip, and normal types of displacement (ERCE 1991; Dames & Moore 1986). Price Canyon trends north-northeast, cross-cutting the regional east-west or northwest-southwest structural grain. The area also contains a less well-defined north-south fault set (Dames & Moore 1986). There are no known active faults in the project area. The proposed project site is not located within an area susceptible to liquefaction or landsliding, according to the County of San Luis Obispo Safety Element.

5.4.1.3 Topography

Elevations within the site range from a high of 607 feet above sea level in the northern segment of the site to approximately 100 feet above sea level on the east side of the site within the Pismo Creek drainage. The topography at the site is characterized by three main hills (rising to elevations of 442, 506, and 607 feet above sea level) separated by valleys at elevations of approximately 200 feet above sea level.

5.4.1.4 Petroleum Occurrence

The Arroyo Grande field is located on the north flank of the Pismo syncline, strata dip southwest; oil-producing zones are deeper in that direction. A structural saddle in the center of the field coincides with a nearly barren zone at depth and divides the field into two major producing areas, north and south. In the northern area, where most of the currently-producing wells lie, the producing zones are shallower and structurally complex, being broken by several inactive faults into roughly half a dozen blocks. The faults isolate the individual blocks, requiring closer and more irregular well spacing to produce the available oil.

A minor amount of natural gas is produced with the oil and is used to fuel the steam generators. Crude oil produced from the Arroyo Grande field has API Gravities ranging from 14 to 22 degrees and 1.6 percent sulfur content, average for California crude oils which range from 0.8 to 2.0 percent sulfur (Lawrence, 1958).

5.4.1.5 Soils

Soils found in the project site are predominantly comprised of weathering products of Pismo formation sandstones. The dominant soil type at the proposed RO plant site is Arnold Loamy Sand is typically developed on 5 to 15 percent slopes. Loamy sands are typically 70 to 90 percent sand with varying percentages of silt and clay constituents making up the remaining 10 to 30 percent.

Figure 5.4-1. Stratigraphic Column for the Price Canyon Area.

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Figure 5.4-2. Major Fault Structures Near Price Canyon

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The parent material for the Arnold loamy sand is derived from unconsolidated material weathered from the nearby siliceous marine sandstones of the Pismo formation. Due to the high quartz content of these weathered materials, the soils derived from them have not been able to develop a significant amount of clay content. This results in a loamy sand texture with a high permeability (i.e., low available water capacity), in turn which leads to limited plant growth and minimal organic matter accumulation (U.S. SCS, 1984).

5.4.2 Impact Analysis

5.4.2.1 Thresholds of Significance

Based on the County of San Luis Obispo's CEQA Guidelines, an impact would be significant if any of the following conditions, or potential thereof, would result with implementation of the proposed project:

1. Exposure of people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving rupture of known earthquake fault, strong seismic ground shaking, seismic-related ground failure, including liquefaction, or landslides;
2. Result in soil erosion, topographic changes, loss of topsoil or unstable soil conditions, from project-related improvements, such as vegetation removal, grading, excavation or fill;
3. Result in the loss of a unique geologic failure;
4. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse;
5. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the General Plan, Area Plan, or Zoning Ordinance) adopted for the purpose of avoiding or mitigating an environmental effect; or,
6. Preclude the future extraction of valuable mineral resources.

5.4.2.2 Short-Term Impacts

Impact GEO-1: Construction of the proposed project may result in a substantial, or potentially substantial, adverse change in the physical condition of the land.

> **Discussion**: Topography will be impacted by construction. The proposed project will require the construction of new soil pads, construction of approximately 14,600 linear feet of pipelines, and the modification of an existing basin. Site disturbance would consist of approximately 13,610 cubic yards of cut and approximately 12,280 cubic yards of fill (with a balance of approximately 1,330 cubic yards), resulting in a total disturbed area of approximately 5.6 acres. The proposed construction would be limited to a canyon within the developed area of the oil field and would not substantially alter the existing topography. Potential soil erosion and vegetation removal impacts would be addressed by Mitigation Measures HYD-1 and BIO-6. Therefore, the physical change to the land is considered adverse, but less than significant.

Impact Category: Class 3

Threshold of Significance: 2

Mitigation Measures: Since no significant impacts were identified, no mitigation is required.

Residual Impacts

None

5.4.2.3 Long-Term Impacts

Impact GEO-2: Construction of new graded pads and proposed detention pond modifications could result in unstable slopes prone to failure during a seismic event.

Discussion: The applicant proposes to utilize an existing unused detention basin for the temporary storage of treated water prior to discharge or re-use at adjacent properties. The pond would be lined to reduce percolation of the stored water. A geotechnical engineering study will be required as a part of the submittal for grading permits. Construction of new graded pads would require approval of a grading plan reviewed by the County Planning and Building Department's grading plan checker. County inspections and independent geotechnical soils testing would be required during the course of grading activities to ensure that the grading activities meet County grading requirements. Mitigation Measure GEO-2 would ensure that impacts associated with slope failure would be less than significant.

Impact Category: Class 2

Thresholds of Significance: 1-5

Mitigation Measure GEO-2: The applicant shall provide the County with a geotechnical engineering report prepared and certified by a State of California licensed geotechnical engineer which addresses slope stability, landslides, liquefaction, settlement, seismic hazards, and expansive soils at the area of proposed facilities. The applicant shall implement the recommendations contained in the geotechnical engineer's report in preparation of grading plans and during construction.

Residual Impacts

No significant residual impacts are anticipated with implementation of the mitigation measure presented above.

Impact GEO-3: The treatment and discharge of produced water could result in decreased oil production due to the loss of reservoir pressures.

Discussion: The proposed project would result in the treatment and discharge of approximately 840,000 gallons per day of produced water generated during oil production activities. Currently, produced water is re-injected into the oil producing formation. Steam is also injected into the oil-producing formation to enhance oil recovery. The applicant has stated that the re-injection of produced water interferes with the ongoing steam injection activities. The removal of water from the oil-producing formation will lower reservoir pressures which could have a negative impact on oil production rates within the oilfield. It is anticipated that the applicant will continue to

monitor reservoir pressures as part of its ongoing reservoir management practices and adjustments would be made to ensure that oil production rates are maintained.

Impact Category: Class 3

Thresholds of Significance: 6

Mitigation Measure: None required.

Residual Impacts

None

5.4.2.4 Cumulative Impacts

Project Sites for the King South Ranch and Tentative Tract Map No.2388 both drain to Pismo Creek. No significant cumulative geologic or soils impacts are anticipated to result from approval of the proposed project. Refer to Section 5.5 for a discussion of potential drainage, erosion, and sedimentation impacts to Pismo Creek resulting from the proposed project and other projects in the Pismo Creek watershed.

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